WHAT WE CLAIM:

1. Three dimensional recording and reproducing apparatus comprising:

a recording medium having N number of recording layers on a substrate;

a laser light source;

an optical system including a focus lens for focusing a light emitted from said laser light source on a k_{th} layer of said recording layers; separating means for separating the light reflected from said recording layer from said emitted light; and an image lens for converging said reflected light; and

photo detector disposed on a focal plane of said optical system and having an effective diameter D given by:

$$D = \lambda/NAI$$

where λ represents the wavelength of said emitted light, and NAI the numerical aperture of said image lens.

2. A three-dimensional recording and reproducing apparatus according to Claim 1, wherein a spot diameter Uk′ of the light reflected from said k_{th} layer placed on said focal plane is given by:

$$Uk' = \lambda/NAI = \lambda fI/a$$

where fI represents the focal length of said image lens, and an effective radius of said image lens.

3. A three-dimensional recording and reproducing apparatus according to Claim 1, wherein the following equation is satisfied:

$$0.1 \geq \Sigma[\delta^2 jk \cdot \alpha jk \cdot (\Delta/Uj')^2]$$

where $\delta^2 jk$ represents a ratio of the transmissivity of an arbitrary j_{th} layer to that of an arbitrary k_{th} layer; αjk a ratio of the reflectivity of the arbitrary j_{th} layer to that of the arbitrary k_{th} layer; and Uj' the diameter of a spot imaged on said focal plane when the light is converged on the j_{th} recording layer.

4. A three-dimensional recording and reproducing apparatus according to Claim 2, wherein the numerical aperture (NAF) of said focus lens, a distance (d) between said recording layers, and a maximum two-dimensional cycle value (bmax) of a particular domain recorded on said recording layer satisfy the following equation:

$$bmax \leq 2d \cdot NAF$$

5. A three-dimensional recording and reproducing apparatus according to Claim 2, wherein inter-layer cross-talk components (f) between a j_{th} layer and said k_{th} layer is smaller than frequency components (1/b) of recording marks recorded on said k_{th} layer.

6. A three-dimensional recording and reproducing apparatus according to Claim 2, wherein said wavelength λ satisfies the following equation:

$$\lambda/4 \geq (1/8NB)(1/NB^2 - 1)NAF^4\Delta d$$

where NB represents the reflectivity of said substrate; NAF the numerical aperture of said focus lens; and Δd a positional range in the optical axis direction in which exists a recording layer on which the light is to be converged.

7. A three-dimensional recording and reproducing apparatus according to Claim 2, wherein the intensity (P) of the light reflected from the recording layer furthest away from a light incident plane of said recording medium satisfies the following equation:

$$P \geq Ik_{th} \cdot Sk/\delta k$$

where Ik_{th} represents a threshold value of the light intensity density on the recording layer furthest away from the incident plane of said recording medium; Sk an area of the light spot when focused on the recording layer furthest away from the incident plane of said recording medium; and δk the overall transmissivity over layers between the light incident plane of said recording medium and said recording layer furthest away from the incident plane.

8. A three-dimensional recording and reproducing apparatus according to Claim 2, wherein said recording medium has one of a ROM (Read Only Memory) layer and a WOM (Write Once Memory) layer.

9. A three-dimensional recording and reproducing apparatus according to Claim 2, wherein said recording medium has a management format on said recording layers, and recording, after performed on said k_{th} layer, proceeds to another recording layer.

10. A three-dimensional recording and reproducing apparatus according to Claim 9, wherein said other recording layer is the $(k \pm 1)_{th}$ layer.

11. A three-dimensional information recording and

reproducing apparatus comprising:

a recording medium including a plurality of stacked recording layers;

information recorded on said recording layers as local optical particular domains;

a focus lens for converging a light on each of said plurality of recording layers; and

a photo detector for detecting the light reflected from said recording medium,

wherein, when the light is converged on an arbitrary layer, a total area of local optical particular domains included in an area defined by the spot diameter on the adjacent layers is substantially constant.

12. A three-dimensional recording and reproducing method, using an information recording medium including a plurality of pairs of recording layer on which optical properties locally change due to a light irradiated thereto and an intermediate layer on an optically transparent substrate, wherein the optical properties of said plurality of recording film layers are changed individually of each other by irradiation of a light spot focused on said each recording layer to record information on said recording film layers, and the light is irradiated to said recording film layers, a reflected light or a transmitting light is imaged by an image lens, and changes in said local optical properties are detected by a photo detector to reproduce information, wherein

the refractivity and thickness of said

optically transparent substrate are represented by NB and d0, respectively;

an intermediate layer and a recording layer are combined as a layer and first to N_{th} layers are designated from the substrate side;

a distance between the centers of adjacent k_{th} and $(k - 1)_{th}$ recording film layers is represented by dk;

the thicknesses of an arbitrary k_{th} recording layer and intermediate layer are represented by dFk and dMk, respectively, and the real parts of the refractivities of the same are represented by NFk and NMk, respectively;

a cycle of changes in the local optical properties on the plane of each layer is represented by <u>b</u> [μm];

the wavelength of a light source in a focusing optical system is represented by λ [μm];

The numerical aperture, effective radius and focal length of the focus lens are represented by NAF, <u>a</u> [mm] and fF, respectively;

The numerical aperture and focal length of the image lens are represented by NAI and fI, respectively; and

the diameter of a light receiving plane of the optical detector is represented by D,

wherein the light focused on a k_{th} layer as a target layer and reflected therefrom is imaged on the focus position of the image lens, and a spot diameter Uk'

on this focal plane is given by:

$$Uk' = \lambda/NAI = \lambda fI/a.$$